

Figure 2-2. Comparison of projected peak demand reductions from demand-side management programs for major Maryland utilities

The utilities have been studying and are in the initial stages of implementing conservation programs (i.e., programs that significantly reduce total energy use). PEPCO has recently obtained approval for programs with financial incentives designed to encourage the installation of energy-efficient lighting for commercial customers and air conditioners for residential customers. DP&L is implementing a commercial lighting program on a pilot basis.

Due to its high load factor and winter-peaking nature, APS (including PE) has found peak shaving programs to be unattractive. Instead, APS encourages its customers to improve the weatherization of homes and commercial buildings, to insulate water heaters, and to use high-efficiency lighting systems in commercial buildings. These are measures designed to reduce demand over many, if not most, hours of the day rather than just the hours of maximum demand.

A detailed discussion of the DSM programs currently being offered may be found in the 1989 Ten-Year Plan of Maryland Electric Utilities prepared by the Maryland PSC. That report describes the major programs and their anticipated impacts.

The PPER Load Forecasts

The load forecast, an essential part of the resource planning process, is used to evaluate future adequacy of service. However, it has also been an area of great uncertainty. PPER has been conducting its own forecast studies on a regular basis in order to provide an independent assessment of the need for new capacity. Since the utilities tailor their capacity plans to their customers' power demands, PPER conducts these studies separately for each of the four major utility systems to monitor the adequacy of service in Maryland.

The forecasts prepared by PPER for annual peak demand in the years 1989 through 2004 are presented on Table 2-8. These forecasts were prepared using sets of econometric models or equations. Once the models are developed, it is necessary to formulate assumptions concerning population growth, local area economic growth, changes in electricity prices, appliance stocks, and other key determinants of demand. The forecast depends to a large degree on these assumptions.

Table 2-9 presents a comparison between PPER's and the utilities' peak demand forecasts for the years 1995 and 2003. The PPER forecasts tend to be somewhat lower than those prepared by PEPCO and APS. By 1995, the PPER forecast exceeds PEPCO's by 169 MW; but by 2003, PEPCO's forecast exceeds PPER's forecast by 314 MW. Similarly, the PPER forecast is 79 MW lower than the APS forecast in 1995, and is 569 MW lower than APS' forecast for 2003. In the case of BG&E, the forecasts diverge, with PPER projecting more rapid load growth over the entire period. PPER's forecast for DP&L is initially lower, but becomes slightly higher by the year 2003. These differences serve to emphasize the importance of demand growth uncertainty in planning for reliable electric service.

Table 2-8				
PPER systemwide peak demand forecasts (megawatts)				
Year	DP&L ^(a)	BG&E ^(a)	PEPCO ^(b)	APS ^(c)
1989	2,162	5,321	5,288	6,214
1990	2,169	5,534	5,383	6,291
1991	2,204	5,747	5,519	6,427
1992	2,247	5,889	5,608	6,546
1993	2,298	6,024	5,693	6,653
1994	2,349	6,174	5,776	6,751
1995	2,396	6,324	5,841	6,842
1996	2,441	6,477	5,876	6,926
1997	2,491	6,642	5,895	6,989
1998	2,542	6,813	5,902	7,039
1999	2,596	6,920	5,909	7,081
2000	2,652	7,174	5,911	7,116
2001	2,708	7,314	5,909	7,174
2002	2,767	7,464	5,911	7,236
2003	2,824	7,626	5,920	7,299
<u>Annual rate of growth (percent)</u>				
1989-1996	1.75	2.84	1.52	1.56
1989-2003	1.93	2.60	0.81	1.16
<p>(a) Includes adjustments for demand-side management and interruptible loads.</p> <p>(b) Includes peak demand reduction from PEPCO's energy use management (EUM) programs in place in 1989 and PEPCO's proposed or approved new EUM. Total peak estimated demand reductions due to PEPCO's EUM programs increase from 288 MW in 1990 to 1,217 MW in 2003.</p> <p>(c) Includes adjustments for demand-side management and interruptible loads; forecast is currently being revised.</p>				

Table 2-9					
PPER vs. company-prepared load forecasts (megawatts)					
	APS ^(a)	BG&E ^(a)	DP&L ^(a)	PEPCO ^(b)	
<u>1995</u>					
PPER	6,842	-	6,324	2,396	5,841
Company	<u>6,921</u>		<u>5,970</u>	<u>2,427</u>	<u>5,672</u>
Difference	(79)	354	(31)		169
<u>2003</u>					
PPER	7,299	7,626	2,781 ^(c)		5,920
Company	<u>7,868</u>	<u>6,930</u>	<u>2,727</u>		<u>6,234</u>
Difference	(569)	696	54		(314)
Source: Tables 2-3 through 2-8.					
(a) Includes adjustments for demand-side management and interruptible loads.					
(b) Includes peak demand reduction from PEPCO's energy use management (EUM) programs in place in 1989 and PEPCO's proposed or approved new EUM programs. Total estimated peak demand reductions due to PEPCO's EUM programs increase from 672 MW in 1995 to 1,217 MW in 2003.					
(c) PPER's forecast for 2003 for DP&L is 2,824 MW. This has been adjusted downward on this table by 43 MW, for comparison purposes, to reflect the 50 MW capacity sale to rural electric cooperatives served by DP&L. DP&L reflects this load adjustment in its official forecast.					

Assessing Future Adequacy of Service

Serving customer demands with a high degree of reliability and at a reasonable long-run cost are the utility planner's primary goals. Reliability means that the utility will have available the power supply resources needed to meet customer demand at all hours of the year. Utilities also prefer, to the extent practical, to avoid the high cost of acquiring and maintaining more resources than needed to meet their minimum reliability standards. Other planning criteria include financial feasibility, environmental impacts, and accommodating risk and uncertainty.

Uncertainties associated with power supply require the utilities to maintain sufficient "reserve capacity," or generating capacity in excess of annual peak demand. These uncertainties include: (a) forced outages of generating units during periods of high demand; (b) the difficulties inherent in predicting peak demand; and (c) unforeseen problems in adding new resources. The target reserve margin of a utility depends on a variety of factors, including the characteristics of the load that it serves, the strength of its interconnections with other utilities, the type and size of its generating units, and its forced outage experience. Based on these factors, Maryland's utilities employ the following target reserve margins for planning purposes (PSC 1989; DP&L 1990; PEPCO 1990):

APS - 25 percent
BG&E - 18 percent
DP&L - 15 percent
PEPCO - 16 percent

Figure 2-3 illustrates the margin between the major Maryland utilities' installed capacity and peak demands, according to utility projections, through 2003 on a combined basis. Figure 2-4 shows the corresponding reserve margins in percentage terms for the same time period.

BG&E and DP&L adhere to PJM standards in setting their planning reserve targets. PEPCO uses several studies and indicators, one of which is the PJM standard, for that purpose. How much reliability a utility system should provide is largely a matter of judgment, and the PJM pool uses the "one day in ten years" standard -- a degree of reliability consistent with the statistical likelihood that demand would not exceed capacity (including potential purchased power) more often than one day in ten years (NERC 1989). As a result of applying this standard, PJM has established a pool-wide desired reserve margin of 22 percent.

An assessment of future adequacy of service (and potential excess capacity problems) must go beyond the projected reserve margins, however, and consider the vulnerabilities of the plans. The most obvious area of uncertainty is the load forecast. Despite very rapid growth during the last few years, Maryland's utilities are projecting relatively slow rates of growth in peak demand -- less than two percent per year in each case. Whether this slow growth takes place depends upon the local service area economies, electric rates, and the willingness of

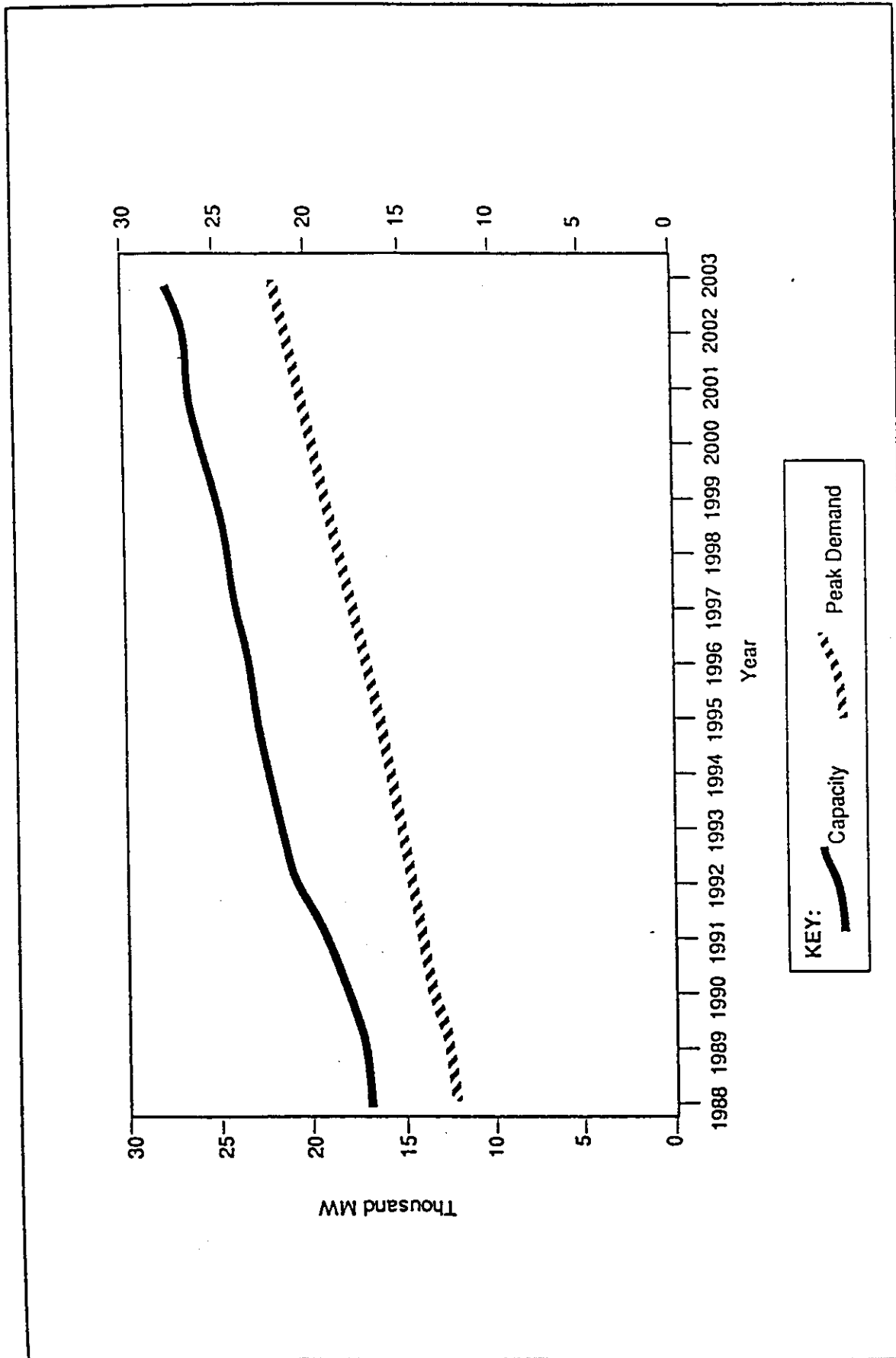


Figure 2-3. Projected total peak demand and capacity for major Maryland utilities (APS, BG&E, DP&L, and PEPCO)

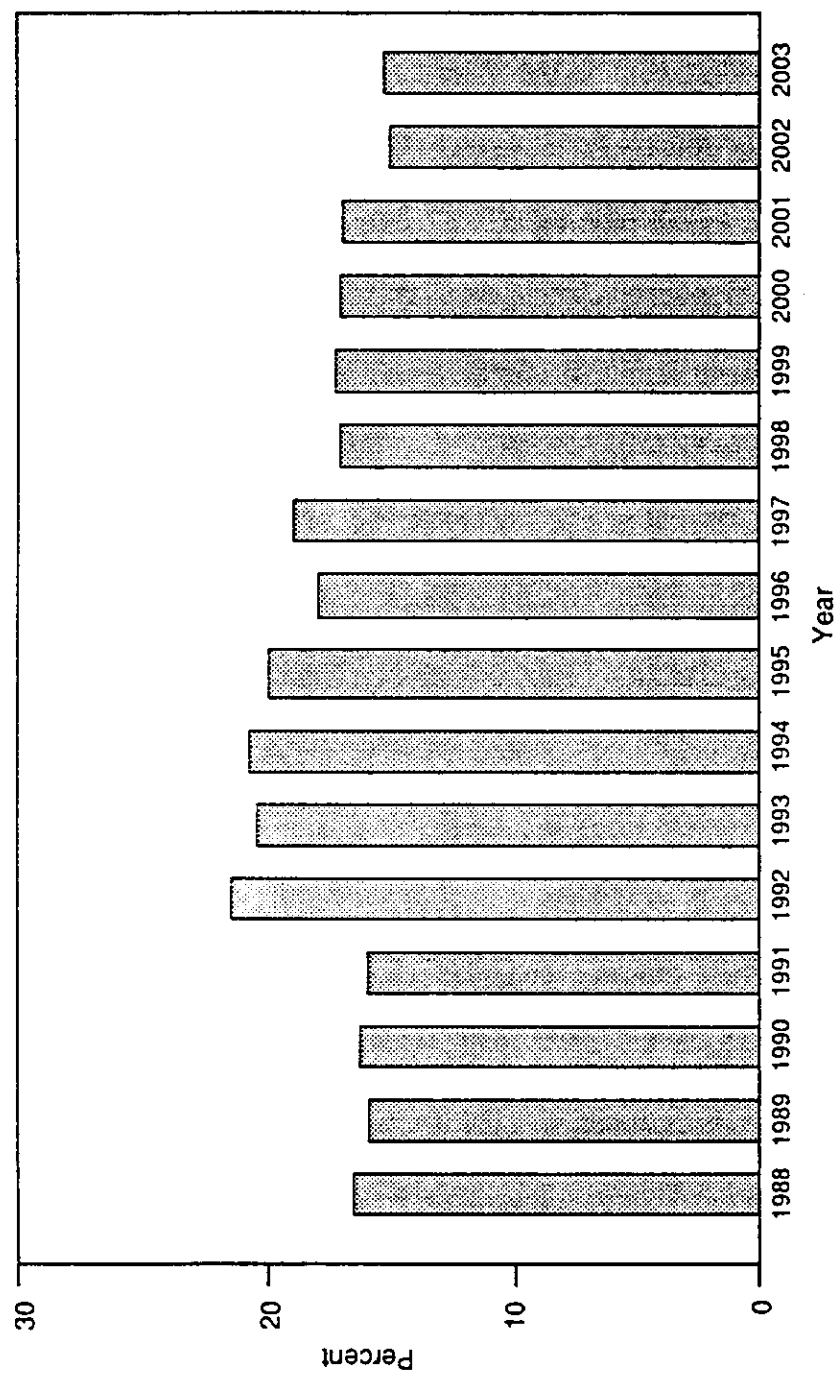


Figure 2-4. Reserve margins for the combined Maryland utilities (APS, BG&E, DP&L, and PEPCO) based on utility projections

customers to undertake conservation and participate in demand-side management programs voluntarily. These projected growth rates are well below historic growth trends (particularly since the mid-1980s) and the load growth currently projected by PPER.

The unexpectedly rapid load growth in recent years has led to a problem of low reserves, at least in the short run, for DP&L, BG&E, and PEPCO. Even using company projections of relatively slow load growth, projected 1990 reserve margins are expected to be less than 12 percent for the three companies. Using the PPER projections, reserves would be even lower. The companies are taking important actions to ensure adequacy of supply in 1991. During that year the 642 MW Brandon Shores Unit 2 enters service, PEPCO obtains 375 MW from its Chalk Point project (and 84 MW from SMECO), and DP&L adds the Hay Road 3 unit.

There is also uncertainty on the supply side. APS is relying very heavily over the next five years on NUG sources to serve load growth. The development of much of that capacity is uncertain due to ongoing litigation. APS has included a "contingency" capacity allowance to cover the possibility that some of that capacity may not go forward, but the contingency is only 50 MW. At present, NUG plays only a minor role in the PEPCO and BG&E resource plans, while DP&L plans to add 129 MW of base load NUG capacity in 1996 through a competitive bid solicitation.

The new sources of supply currently include the 642 MW Brandon Shores Unit 2 (BG&E), substantial additions of gas-fired combustion turbine or combined cycle units (PEPCO, BG&E, and DP&L), and purchased power (PEPCO and BG&E). There appear to be no unusual reliability concerns with these resources. Combustion turbines and combined cycle plants have relatively short lead times, and can quickly accommodate resource plan changes.

In assessing the risks described above (particularly with load growth), it is necessary to examine the flexibility provided by the supply plans. The Maryland utilities promote their flexibility with (a) mothballed capacity; (b) altering the timing (and amount) of new combustion turbine capacity; and (c) exercising purchased power options. APS has placed its Springdale and Mitchell units, oil-fired steam generating units, in cold storage reserve status. It has done so because it presently has sufficient capacity to serve its load, and because the Springdale and Mitchell units are relatively expensive to operate. APS plans to reactivate these units during the period 1994 to 1997, but if its peak load grows faster than expected, their return to service can be accelerated as needed.

The resource plans submitted by the utilities in 1990 to the Maryland PSC indicate that reserves generally will be adequate through 2003, but there are a number of risks. For all four Maryland utilities, reserve margins are currently below desired levels. With subsequent resource additions, the margins will rise to near the target levels. PEPCO's margin should be at or above the target 16 percent minimum by the mid-1990s, although that result depends upon the assumption of substantial savings from DSM programs.

The major risk is that load growth will be more rapid than the utilities are currently projecting, which is the outlook forecast by PPER. Timely recognition of these trends and quick action will be required to avoid a capacity shortfall. An example of such a scenario is PEPCO's application to license four combustion turbines at Chalk Point (PSC Case No. 8228). PEPCO obtained its regulatory approvals on an expedited basis (holding hearings in 1990 for a 1991 in-service date) due to its past underestimate of load growth. The other Maryland utilities will also need to be prepared to respond to rapid load growth.

The adequacy of service will depend upon the availability of both existing and planned capacity resources. For example, the unavailability of BG&E's Calvert Cliffs plant and PECO's Peach Bottom plant due to operating and mechanical difficulties reduced regional reliability during the summers of 1988 and 1989. The blackout experienced by PEPCO and BG&E in July 1990 was attributed to a combination of low reserves and the unexpected outage of PEPCO's Chalk Point Plant. The new capacity planned for the 1990s is principally combustion turbines and combined cycle plants. This type of capacity is very flexible from both a timing and siting standpoint. Lead times are relatively short, allowing the utility to react quickly to changing trends. Although this appears to be a feasible strategy, reliability of service will need to be closely monitored during the 1990s. Utility resource planning is occurring in an environment in which the margins for error are small. Their flexibility and "quick response" capabilities are likely to be tested during the 1990s.

E. Socioeconomic Impacts of Planned Capacity Additions

This chapter has emphasized Maryland's substantial need for new resources during the next 10 to 15 years. The state's utilities are planning on an "integrated" basis, meaning they are considering the full range of resource options, including purchased utility power, purchases from NUG facilities, and DSM programs. However, the primary resource during the 1990s is expected to be the conventional central station power plant.

Need for power often translates into a need for land. PEPCO has planned major expansions at its Dickerson and Chalk Point generating stations. In late 1989, BG&E filed an application for a series of capacity additions at its Perryman generating station. DP&L has indicated plans for construction of a series of coal-fired atmospheric fluidized bed combustion (FBC) facilities beginning in the late 1990s (see Chapter 3 for a discussion of this technology). Candidate sites have been identified, including a preferred site (Nanticoke) near Vienna, in Dorchester County. Potomac Edison is relying primarily on NUG purchases to serve load growth and has no plans at present to construct new capacity in Maryland. Hence, DP&L is the only Maryland utility considering the need for acquiring a new power plant site in the state.

Although the resource requirements for the construction and operation of major generating facilities are typically substantial, the short-run social and economic effects of capacity expansion in Maryland are expected to be modest. Near-term capacity additions will be primarily simple cycle combustion turbines, which are

relatively inexpensive to build. In addition, a significant portion of planned capacity is sited on land already owned by the utilities, although about 400 acres of the Perryman site are currently under cultivation (ERM 1986). Both of PEPCO's projects are sited on property where operational generating capacity already exists.

With the conversion of Station H and Perryman facilities to combined cycle and possibly to integrated gasification combined cycle units, and with the possible construction of an FBC facility by DP&L (see Chapters 3 and 9 for explanation of these technologies), the impacts of developing new capacity could become significant in the latter part of the 15-year planning period. The land requirements of PEPCO's and BG&E's coal gasification units, for example, will essentially exhaust the capacity of the Dickerson and Perryman sites and will require the acquisition of off-site land for the storage of combustion by-products. The sites DP&L has considered for its contemplated base load facility include enough land to store fuel and by-products, but, since no candidate sites are currently owned by the utility, acquisition of a site will pre-empt land from other uses.

The development of the additional generation capacity called for in the Maryland utilities' power supply resource plans will necessarily involve trade-offs. As mentioned earlier, the need for power must be balanced against the resource requirements of new generation facilities, such as land, water, and other inputs. In addition, the construction and operation of these plants will generate external effects that could temporarily or permanently change the course of economic development in impacted areas.

Not all of the impacts of facility development will be negative. Construction activities can pump considerable income into local economies through construction wages and local purchases of goods and services. Furthermore, power plant projects provide significant tax revenue for county and state governments. However, these benefits come at a price. The influx of construction workers can temporarily strain the resources of local governments, while power plant structures can detract from the quality of local scenery.

Economic, Demographic, and Fiscal Impacts

In general, the economic impacts of the planned combustion turbine generating projects are expected to be modest. The employment requirements of this technology in the construction stage are smaller than for other types of power plants because much of the equipment is fabricated off site. Furthermore, as peaking capacity, its operational employment requirements are quite small. The modest employment demands associated with these projects will therefore add fewer dollars but will also place fewer demands upon the local economy than would those associated with conventional base load facilities.

Situated as they are near major metropolitan areas, the construction employment requirements of Chalk Point and the initial stages of Station H and Perryman are expected to be largely satisfied locally by workers living within commuting

distances of the construction sites. Although impacts of these facilities are generally expected to be minor, demands could temporarily strain or exceed the service capacities of local infrastructures such as roadways during peak construction activities. These periods, however, are expected to be relatively short in duration.

The economic impacts from later stages of Station H and Perryman (after the year 2000) could be significant if PEPCO and BG&E decide to build coal gasification plants. Although the construction and operations employment requirements for facilities of this type have not yet been determined, they are substantially higher than those needed to build and operate combustion turbine or combined cycle units. The economies around the Dickerson and Perryman sites therefore may be affected early in the next century.

The economic impacts of DP&L's planned new capacity could be fundamentally different from those generated by the PEPCO and BG&E facilities, as the site is likely to be located on Maryland's Eastern Shore. As a coal-fired facility, its construction and operations requirements are greater. Furthermore, most candidate sites, including the preferred site, are situated where construction labor is in short supply, and are relatively distant from the labor pools of major metropolitan areas in Delaware and Maryland (Hall 1989). It would not be unreasonable to expect some degree of population in-migration, attributable to construction employment, to the host and surrounding counties, particularly if construction is staged over several years.

Although DP&L's new facility would add income to the Eastern Shore economy, it could also generate service demands upon local economies that are currently struggling to satisfy existing population growth. Over the long term, however, the benefits of the facility, primarily in the form of tax revenues, are expected to more than outweigh the costs, which would be largely temporary and related to construction activities.

Land Use Impacts

The land use impacts of the development of near-term capacity additions are generally expected to be modest in magnitude, but they highlight state-wide concerns about the allocation of resources. Though the two concepts are not completely distinct, we can consider land use impacts in terms of either land conversion or land pre-emption.

Land conversion can mean a change in land use in a zoning sense, such as from residential to commercial, or in the intensity of use, such as from low-volume to high-volume retail activity. In general, land conversion from economic development stimulated by the construction and operation of combustion turbine facilities is not anticipated around the Dickerson, Perryman, or Chalk Point sites because the economic stimulus is expected to be small (PPER 1989; ERM 1986). Nor is land conversion expected from the construction and operation of combined cycle facilities at Dickerson and Perryman. Little land conversion is anticipated

to be stimulated by DP&L's proposed facility, even though the economic impacts will be slightly greater (Hall 1989).

Land pre-emption, however, is a concern in the siting of DP&L's facility and is a potential concern for the Dickerson and Perryman sites if PEPCO and BG&E construct gasifiers there. If DP&L locates its new capacity at its preferred site near Vienna, the facility will remove about 850 tillable acres of agricultural land from Maryland (Hall 1989). Although this represents less than one-half of one percent of all agricultural land in Dorchester County, the loss of farmland to development is a continuing concern for the State. Even though land at DP&L's alternative sites is less favorable to agriculture, development of the facility at those sites would also effectively pre-empt other land uses for two or three generations.

Land pre-emption impacts will become an issue if gasification plants are constructed at the Dickerson and Perryman sites, because neither site contains adequate acreage for the storage of combustion by-products. Depending upon terrain, setbacks, and other factors, each facility could pre-empt several hundred acres to store by-products.

Impacts on Cultural and Historical Resources

Maryland's strong ties to its cultural and historical heritage are reflected in the State's effort to consider them in all major public policy decisions. As a result, through the activities of organizations such as the Maryland Historical Trust and land use regulations embodied in local zoning ordinances, sites having warranted cultural or historical merit are given some degree of protection from development activities that could potentially impact them.

Large-scale development activities can demolish important structures or disturb historical, cultural, or archaeological sites. Development can also threaten these resources by impacting visual quality, for example, by erecting industrial structures in an otherwise historical setting.

In most respects, the impacts on cultural and historical resources of the new capacity identified in company resource plans are expected to be minimal. Since initial development activities for three of the four facilities will be on company-owned property, the potential for disturbing cultural resources is significantly diminished, particularly since two of the sites are currently occupied by existing generation capacity. A preliminary assessment of candidate sites for DP&L's FBC facility has identified no structures, sites, or districts of significance that will be seriously impacted by the project (Hall 1989). Evaluations of alternative sites for storing combustion by-products from coal gasification facilities with respect to impacts on cultural and historical resources are currently incomplete.

Impacts on Visual Quality

All power plant sites in the resource plans of Maryland's utilities are located in rural areas of the state. This siting strategy exposes fewer permanent residents to facility structures, but has the disadvantage of creating an industrialized

landscape that contrasts sharply with the rural surroundings. Though the planned construction projects may seem at odds with state policies that identify and designate scenic highways and rivers, their visual quality impacts are not expected to be significant.

Since both of the PEPCO sites, for example, already house generation facilities, the visual quality impacts of the new facilities will be marginal. Although a detailed evaluation of visual quality impacts of BG&E's Perryman project has not yet been conducted, the site appears to be adequately buffered from local populations. Visual quality impacts associated with DP&L's new capacity will probably be localized because of the local terrain and buffering. The facility should therefore affect few permanent residents.

Visual quality impacts remain a concern to DNR, however. These concerns can be seen in several issues associated with the Dickerson and Perryman sites. First, new facility structures at Dickerson will impact major recreational resources in western Montgomery County and eastern Frederick County because of the proximity of the site to the C&O Canal National Historic Park and Sugarloaf Mountain. To some extent, these impacts will be mitigated by existing structures on site and by vegetation, which will obscure the facilities from many perspectives when usage of these resources is greatest (PPER 1989).

Second, visual quality impacts are partly a function of the technology used to generate electricity. The combustion turbine and combined cycle structures currently planned for the two sites have relatively low profiles and short stacks. They are not expected to intrude visually upon local scenery to a large extent. The structural characteristics of coal gasification facilities are more uncertain, and their visual impacts are currently unknown.

Finally, the Station H and Perryman projects, if fully developed, will generate off-site visual quality impacts from coal by-products storage facilities. Since the location of the by-products sites and dimensions of the ash piles have not been determined, their visual impacts are not known but will be investigated as information becomes available.

F. References

BG&E (Baltimore Gas & Electric Company). 1989. Integrated Resource Plan 1989-2003.

ERM (Environmental Resources Management, Inc.). 1986. Preliminary environmental review, Perryman site. Prepared by Environmental Resources Management, Inc., West Chester, PA, for Maryland Department of Natural Resources, Power Plant Siting Program, Annapolis, MD.

- Estomin, S.L. 1989a. Electric Power Supply in Maryland Through the Year 2020. Working paper prepared by Exeter Associates, Inc., Silver Spring, MD, for the Maryland Department of Natural Resources, Power Plant and Environmental Review Division, Annapolis, MD.
- Estomin, S.L. 1989b. Electric Power Demand in Maryland Through the Year 2020. Working paper prepared by Exeter Associates, Inc., Silver Spring, MD, for the Maryland Department of Natural Resources, Power Plant and Environmental Review Division, Annapolis, MD.
- Hall, P.D. 1989. Estimated socioeconomic impacts from DP&L's proposed Nanticoke facility at Vienna, Maryland. Prepared for Maryland Department of Natural Resources, Power Plant and Environmental Review Division, Annapolis, MD.
- PPER (Maryland Department of Natural Resources, Power Plant and Environmental Review). 1989. Environmental review of Potomac Electric Power Company's proposed Station H Element I. Prepared by the Maryland Department of Natural Resources, Power Plant and Environmental Review Division, Annapolis, MD. PPSE-SH-1
- PPRP (Maryland Department of Natural Resources, Power Plant Research Program), 1988. Power Plant cumulative environmental impact report. Prepared by the Maryland Department of Natural Resources, Power Plant Research Program, Annapolis, MD. PPRP-CEIR-6.
- PSC (Public Service Commission of Maryland). 1989. Ten-Year Plan (1989-1998) of Maryland Electric Utilities. Prepared for the Department of Natural Resources, Annapolis, MD.
- NERC (North American Reliability Council). 1989. 1989 Reliability Assessment.
- OTA (Office of Technology Assessment). 1985. New electric power technologies: problems and prospects for the 1990s. U.S. Congress, Office of Technology Assessment, Washington, DC. OTA-E-246.
- PE (Potomac Edison Company). 1989. 1989 Long-Range Plan of the Potomac Edison Company.

G. Glossary

Avoided costs. The costs that a utility saves by supplying one unit less of electric power. Avoided cost typically serves as the basis for the rates paid by the local utility when it purchases power from a non-utility generator.

Base load plant. A power plant built to operate around-the-clock. Such plants tend to have low operating costs and high capital costs and are best utilized by running steadily. Coal and nuclear fueled plants are typical base load plants.

Curtailable service. A type of electric service whereby the utility offers discounted rates to customers willing to have their electricity service curtailed on those rare occasions when the utility is short of generating capacity.

Demand-side management (DSM). Utility programs designed to reduce demand, particularly during peak demand periods, or shift demand to the off-peak period. DSM programs may include time-of-use rates, appliance efficiency incentives, curtailable or interruptible rates, and other programs.

Economic dispatch. An operating procedure employed by utility systems to minimize fuel costs by dispatching the lowest-operating-cost generating units to supply base load energy requirements and dispatching higher operating cost plants only as system demand requires their use.

Independent power producers (IPPs). Non-utility electricity suppliers not eligible for "qualifying facility" status under federal rules.

Interchanges. Intercompany power flows between members of a power pool or power system, generally of a short-term nature.

Interruptible service. See "curtailable service."

Investor-owned utility (IOU). Large, integrated electric system typically engaged in the production, transmission, and retail distribution of electricity.

Municipal utilities. Utilities generally owned and operated by municipalities. In the case of Maryland, the municipal utilities obtain the vast majority of their electric power from the four investor-owned utilities.

Peak demand. The maximum electricity demand over a one-hour period placed on a utility system. For example, the "annual peak demand" is the maximum hourly demand during a given calendar year.

Peaking plants. Power plants that operate for a relatively small number of hours, usually during peak demand periods. Such plants usually have high operating costs and low capital costs.

Power pool. An inter-utility organization that "pools" the member utilities' generation resources to enhance the reliability and reduce operating costs of electric service for participating utilities.

Qualifying facilities. Non-utility generators meeting certain prescribed federal technical standards. Such plants may be cogenerators or those that operate using renewable or waste fuels.

Reliability councils. Regional organizations formed by the electric utilities to coordinate utilities' generation and transmission systems and monitor the availability of electric services.

Rural electric cooperatives. Operated by and for member customers with most of the capital financing provided by the federal Rural Electrification Administration (REA). At present, the Maryland electric cooperatives distribute power purchased from IOUs, but do not own any significant generating capacity.

Reserve margin. Total system generating capacity minus annual system peak demand, divided by the annual system peak demand.

Time of use rates. A utility rate structure that charges higher rates during peak hours of the day in an effort to shift peak period demand to off-peak hours.

CHAPTER 3

AIR IMPACT

A. Introduction

The combustion of large quantities of fuel in fossil-fueled power plants has the potential to produce significant air pollutant emissions. In the past, attention has primarily been focused on the ground level concentrations of these air pollutants. This is particularly true for the criteria pollutants, those substances for which National Ambient Air Quality Standards (NAAQS) have been established. Although power plants generally have relatively large amounts of emissions, the exhaust gases from power plants are usually discharged at high temperatures and from stacks having heights sufficient to disperse the pollutants over a large area. This results in relatively low concentrations of the pollutants in the ambient air breathed by the public.

Although a demonstration is still required to show that air quality standards are not jeopardized by the operation of new power plants, the ability to attain these standards is usually not a major issue in power plant licensing. For most of the criteria pollutants, control of pollutant emissions from existing sources has reduced pollutant levels in the ambient air to well below air quality standards. In recent years, however, there has been an inclination toward controlling emissions even when air quality standards are being met. Additionally, there have been growing concerns over toxic air emissions, the global environment, and acid rain. These concerns are reflected in the 1990 Amendments to the Clean Air Act. Sections of the Amendments contain provisions related to sulfur oxides (SO_x), nitrogen oxides (NO_x), and air toxics control that could significantly affect the environment and the utility industry in Maryland.

Isolated issues related to the attainment of air quality standards still exist. Violations of ozone standards are considered a major problem, but the role of power plant emissions in such violations is uncertain. Regulations have been established to limit increases in NO_x concentrations of outdoor air. Also, concern over the effects of fine particulate matter has resulted in a revision of the NAAQS for particulate matter from a standard for total particulates to a standard for PM_{10} , those particles less than 10 micrometers (microns) in diameter. Such particles are more likely to produce adverse health effects than larger ones. These new regulations must be considered in the licensing of new power plant facilities.

Maryland utilities are planning considerable expansions in the coming decade, which will change the amount of pollutants emitted to the atmosphere. For example, new power generation facilities are currently proposed at Dickerson, Chalk Point, Perryman, and Easton. Also, the role of small utility generators and non-utility generation may be increasing. The smaller units could have a more significant environmental impact per unit of electricity produced than do the larger utility power plants, and could in aggregate have greater overall impacts on Maryland's environment.

In this chapter, as in past CEIRs, the trends and cumulative environmental impacts associated with power plant air pollutant emissions are discussed. This CEIR also addresses the current and impending environmental issues associated with pollutant emissions from power plants.

Important issues considered in this chapter include:

- the past and present air quality impacts of existing electric utility sources in the state, and the significance of these impacts;
- the potential for long-term health and welfare effects from continued exposure to power plant emissions;
- the factors that might influence future emissions, including new control technologies and more stringent regulations; and
- the constraints that may be imposed on utilities because of environmental concerns and new regulations.

The following section furnishes background information describing the regulations that pertain to Maryland power plant emissions and likely changes to these regulations that could affect the generation of electricity. The subsequent sections discuss the impacts and issues associated with emissions of SO_x, NO_x, ozone, carbon monoxide (CO), toxics, and particulate matter, as well as the global environment and other concerns related to the production of electricity. The final section summarizes and integrates the discussion.

B. Background

Regulation of Power Plant Emissions

Air pollutant emissions from power plants are regulated at both federal and state levels. The Clean Air Act of 1963 (CAA) and its subsequent amendments in 1970 and 1977 establish the legal basis for federal regulations that restrict power plant emission rates and ambient air quality impacts. The Act authorizes the federal government, through the U.S. Environmental Protection Agency (EPA), to set standards for the control of air pollution. These standards include NAAQS, New Source Performance Standards (NSPS), National Emissions Standards for Hazardous Air Pollutants (NESHAPs), and New Source Review (NSR) requirements, which includes the Prevention of Significant Deterioration (PSD) program. Each state is required to develop a State Implementation Plan describing how the federal standards and requirements will be met in the state and how state laws and regulations will be implemented to ensure compliance with federal requirements. In Maryland, in addition to adopting the federal regulations, state regulations include specific emissions limitations for several pollutants, ambient air quality standards for gaseous fluorides, and specific requirements for review of new electric generating facilities.

This section describes the overall federal requirements and specific state requirements that apply to power plants, and changes in those requirements since the 1988 CEIR was prepared.

- Federal Regulatory Framework

The CAA requires the EPA Administrator to maintain a list of pollutants that he or she determines "may reasonably be expected to endanger" public health or welfare, and which are emitted from numerous or diverse stationary or mobile sources. For each of these pollutants, the Act directs the Administrator to prepare a "criteria document" detailing the health and welfare impacts of the pollutant and to establish NAAQS. The NAAQS include two sets of standards: 1) primary standards, which are established to protect the health of the general public with an adequate margin of safety; and 2) secondary standards, which are established to protect public welfare (e.g., to prevent damage to livestock, vegetation, man-made materials, and the economic value of objects).

On 30 April 1971, NAAQS were promulgated for six pollutants that are commonly referred to as "criteria" pollutants: SO₂, total suspended particulate matter (TSP), CO, non-methane hydrocarbons (NMHC), nitrogen dioxide (NO₂), and photochemical oxidants. The NMHC standard has since been revoked (5 January 1983). The photochemical oxidants NAAQS was revised to cover only ozone. A NAAQS for lead was subsequently promulgated, and the TSP standard replaced by one for PM₁₀. The current state and national ambient air quality standards are listed in Table 3-1.

In 1977, Congress codified the Prevention of Significant Deterioration program to prevent deterioration of air quality by major new sources and major modifications in clean air areas. PSD "increments," which limit the allowed increases of pollutant levels over those in a baseline year, were established in the CAA for TSP and SO₂. Increments were established for Class I (pristine, such as National Parks), Class II (general), and Class III (industrialized) areas. There are currently no areas designated as Class III in the U.S. Increments have subsequently been established for NO₂ and have been proposed for PM₁₀ (Table 3-2).

To ensure protection of the environment, requirements have been established for major sources of PSD pollutants. These include:

- Application of pollutant-specific Best Available Control Technology (BACT), established on a case-by-case basis taking into consideration energy, environmental, and economic impacts.
- Ambient air quality impact analyses, including both air quality projections and ambient monitoring, to determine whether the allowable emissions from the new source would cause or contribute to an exceedance of any NAAQS, PSD increment, or other ambient air quality limitation. Impact analyses are required for pollutants regulated under the CAA, with the exception of ozone.

Table 3-1
State and national ambient air quality standards (NAAQS)

Pollutant	Averaging Period	Air Quality Standards ($\mu\text{g}/\text{m}^3$)	
		Primary	Secondary
PM10	Annual (arithmetic mean)	- 50	50
	24-hour ^(a)	150	150
Sulfur Dioxide	Annual (arithmetic mean)	80	--
	24-hour ^(a)	365	--
	3-hour ^(a)	--	1300
Nitrogen Dioxide	Annual (arithmetic mean)	100	100
Ozone	1-hour ^(b)	235	235
Carbon Monoxide	8-hour ^(a)	10,000	10,000
	1-hour ^(a)	40,000	40,000
Lead	Calendar quarter	1.5	1.5
Gaseous Fluorides ^(c)	24-hour	1.2	1.2
	72-hour	0.4	0.4

Source: 40 CFR 52 Subpart V.

^(a) Concentration not to be exceeded more than once per year.

^(b) Expected number of days in which one or more hourly ozone concentrations exceed this value must be less than or equal to 1.

^(c) Not an NAAQS; applies to Maryland only (COMAR 26.11.04).

Table 3-2
Prevention of significant deterioration increments ($\mu\text{g}/\text{m}^3$)

Pollutant	Averaging Period	Class I	Class II	Class III
TSP	Annual	5	19	37
	24-hour ^(a)	10	37	75
SO ₂	Annual	2	20	40
	24-hour ^(a)	5	91	182
	3-hour	25	512	700
NO ₂	Annual	2.5	25	50
PM10 ^(b)	Annual	4	17	34
	24-hour	8	30	60

Source: 40 CFR 51-52.

^(a) Concentration not to be exceeded more than once per year.

^(b) PM10 increments were proposed 5 October 1989.

Note: All of Maryland is designated Class II area.

- Assessment of the effects of the proposed project and its associated secondary growth (commercial, residential, industrial, and other) on soils and vegetation, and on visibility in Class I areas.

As for source-specific regulations, NSPS exist for a variety of source categories, including commercial electric generation boilers and turbines. These standards are based on the pollution control technology available to each particular category of new sources and are intended to establish minimum pollution control technology requirements in attainment areas (areas in which the ambient levels of pollutants are below the NAAQS). The requirements apply to each new facility and any modification of an existing facility that commences construction after the date of the proposal of the NSPS. Details of the applicability of various NSPS requirements to Maryland utilities may be found in subsequent sections.

Hazardous pollutants are addressed through NESHAPs. These standards are established to protect public health in the vicinity of major sources of hazardous air pollutants. NESHAPs are both pollutant- and source-specific. Currently, NESHAPs have been promulgated for the following pollutants: asbestos, benzene, beryllium, inorganic arsenic, mercury, radionuclides, and vinyl chloride. Power plants are not subject to the NESHAP regulations, but must quantify emissions of all NESHAP pollutants during PSD permitting.

- Maryland State Regulatory Framework

Maryland air pollution control regulations are developed under the authority of the Maryland Department of the Environment (MDE) through its Air Management Administration (AMA). For administrative purposes, Maryland is divided into six Air Quality Control Regions (AQCRs) (see Figure 3-1). MDE operates ambient monitoring stations throughout the state to determine the attainment status of each AQCR. Areas where the ambient level of any criteria pollutant exceeds its NAAQS are designated as "non-attainment" for that pollutant. Non-attainment areas in Maryland include the Baltimore and Washington, D.C. metropolitan areas (Areas III and IV), which are non-attainment for ozone, and localized carbon monoxide non-attainment areas in metropolitan Baltimore and suburban Washington. Monitoring and modeling activities are underway at MDE to determine the PM₁₀ attainment status for the Baltimore metropolitan area.

Maryland has incorporated into its air quality management program the federal requirements for review of new sources. Maryland's NSR requirements are similar to federal requirements, but include additional provisions related to toxic air pollutants (TAPs) as well as SO₂ and PM emissions. The air toxics provisions regulate emissions of TAPs from both new and existing non-utility sources.

For the non-attainment areas of Maryland, the MDE regulations contain special requirements for new sources impacting on a non-attainment area (NSINA). In Maryland, these requirements are applicable to new and modified sources in the Washington and Baltimore metropolitan areas emitting more than 50 tons per year of volatile organic compounds (VOCs). NSINA regulations require:

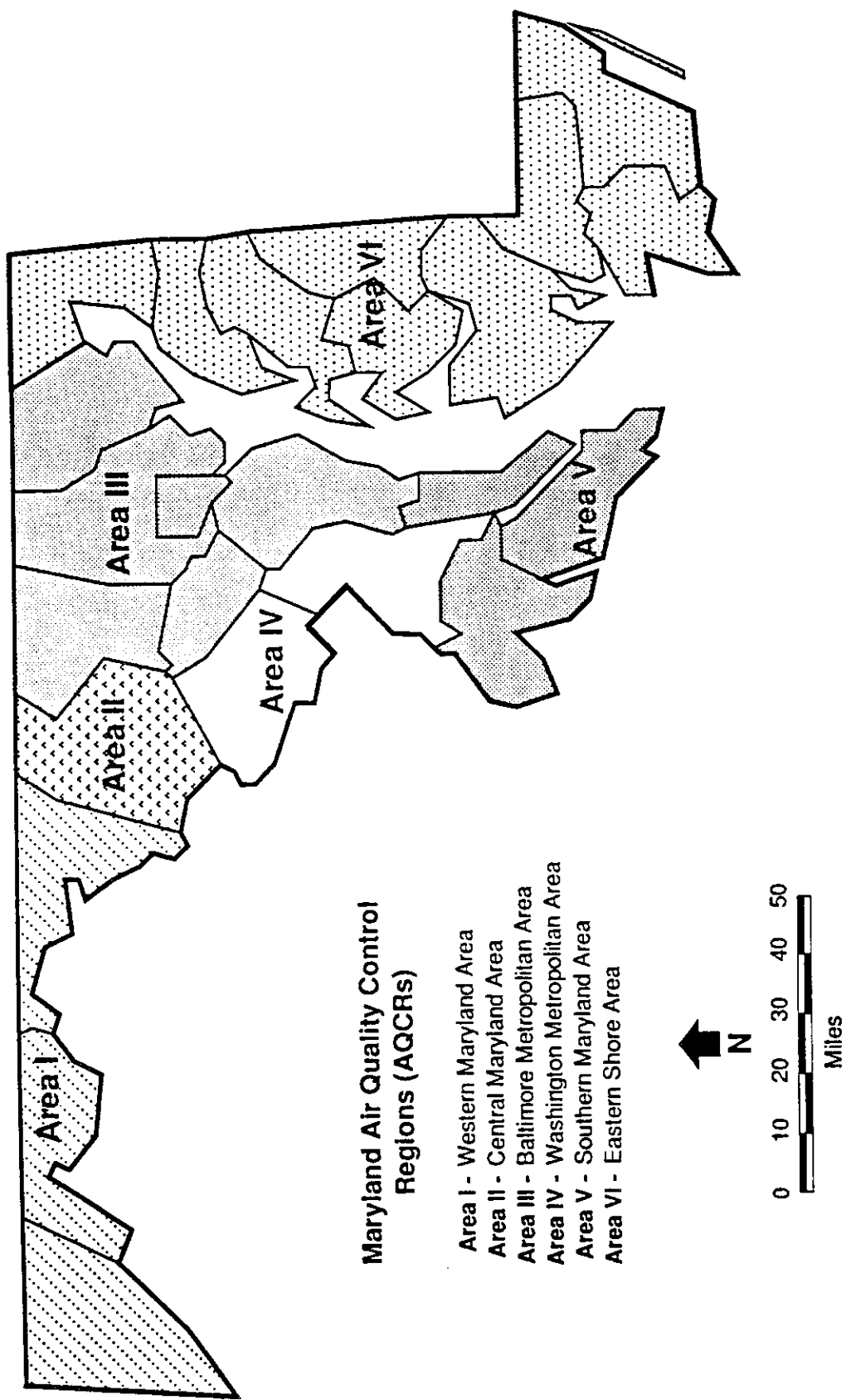


Figure 3-1. Air quality control regions (AQCRs) of Maryland

- limitation of emissions from each new source to the Lowest Achievable Emission Rate (LAER) for such sources (i.e., the most stringent emissions limitation achieved for any similar source anywhere in the country, regardless of cost);
 - certification by the owner that all other sources owned by him or her are in compliance with all applicable emission standards; and
 - emissions offsets (reductions in emissions from other nearby facilities) that compensate for the emissions of the proposed new source.
- Approvals for a New Power Plant

An electric utility planning to construct a new generating station or expand an existing facility in Maryland must file an application with the Maryland Public Service Commission (PSC) for a Certificate of Public Convenience and Necessity (CPCN). The PSC's filing requirements for a CPCN prescribe specific environmental information that must be included in the application. In particular, the application must include a description of the effects on air quality, including compliance with federal and state standards. Accordingly, the CPCN granted by the PSC for power plant construction and operation conveys approval under the authority of the PSD regulations and any other permitting requirements administered by AMA.

Changes in the Regulatory Environment

Since the publication of the last CEIR, important modifications have been made in national NSR requirements. Additionally, MDE air toxics regulations have been implemented to limit emissions of toxic air pollutants. New provisions have also been incorporated into the federal Clean Air Act Amendments of 1990.

• New Source Review Requirements

Several important changes in the NSR requirements that have occurred since the 1988 CEIR include the promulgation of NO₂ PSD increments, the proposal of PM₁₀ increments, and procedural changes in the way BACT requirements are determined. The implications of these changes in NSR requirements with regard to specific pollutants are discussed in subsequent sections. The change in BACT policy is discussed below.

One of the most important requirements of PSD review for major new sources and major modifications is the determination of an emission rate that represents Best Available Control Technology, taking into account economic, energy, and environmental considerations. Probably the most significant change to the PSD program is a policy change stipulating the way in which BACT is determined.

In the past, BACT demonstrations prepared by applicants have started with a base case and demonstrated that more stringent control alternatives would result in unacceptable environmental, energy, or economic impacts. Recent EPA policy

guidelines require applicants to start by evaluating the control technology that results in the lowest emission rates. This includes those technologies developed for lowest achievable emissions rates for a similar or identical source or source category. This "top" level of control is then evaluated for its technical feasibility, with consideration given to the technology's environmental, energy, and economic impacts. If the top control technology is shown to be technically infeasible or to result in unacceptable energy, environmental, or economic impacts, then the next most effective control technique is similarly evaluated. This process continues until an appropriate, technically feasible, and cost-effective control technology is chosen.

EPA has also taken steps to intensify its oversight review of BACT determinations made by state agencies in order to assure uniformity among the states in the application of BACT. Top-down BACT analyses and increased EPA review have resulted in more stringent BACT decisions throughout the nation, causing a profound effect on the licensing of power plants in Maryland.

- **Maryland Air Toxics Regulations**

On 29 July 1988, MDE adopted regulations requiring most existing sources with state air emissions permits and proposed sources to identify and control emissions of certain carcinogens and other pollutants that could adversely affect public health. Most fuel-burning sources are currently exempt from the majority of these regulations. Utility boilers that use refuse-derived fuels, however, are subject to the Maryland air toxics regulations. The requirements include quantification of toxic emissions, and a compliance demonstration that may show either that emissions meet certain screening criteria or, through a risk analysis, that public health will not be adversely affected by the emissions.

- **Clean Air Act Amendments**

In the fall of 1990, the Administration and Congress negotiated a Clean Air Act reauthorization bill referred to as the Clean Air Act Amendments of 1990. Sections of the amendments address non-attainment standards for ozone, carbon monoxide, and particulate matter; mobile sources; air toxics; permits; acid rain; enforcement; and other miscellaneous issues. The amendments provide for reductions in SO₂ and NO_x for acid deposition control using a system of marketable permits. The impacts of these proposed provisions on Maryland utilities are discussed in more detail in Section C of this chapter and in Chapter 8. Power plants in Maryland may also be affected by portions of the proposed bill that deal with air toxics and non-attainment standards. The potential impacts of these two sections of the proposed amendments on the utility industry are discussed in the pollutant-specific sections of this report.

C. Nitrogen and Sulfur Oxides Emissions

Two pollutants emitted by fossil fueled power plants in relatively large quantities are oxides of nitrogen and sulfur. This section contains a discussion of the potential adverse impacts of these pollutants, the ways in which they are formed,

the applicable regulatory standards and requirements, control schemes that are currently used, and those that may be implemented in the future. Also included is a discussion of how future regulatory requirements may affect power plant emissions. A summary of SO₂, NO_x and PM emissions is found in Appendix A.

For the purpose of demonstrating compliance with emissions standards, all oxides of nitrogen are grouped together and expressed as NO_x. Compliance with ambient air quality standards is based on the NO₂ content of the nitrogen oxide mixture, which may be conservatively estimated by assuming that all of the emitted NO_x is converted to NO₂.

Emissions of SO_x are composed predominantly of SO₂, with minor quantities of sulfur trioxide (SO₃), and gaseous and particulate sulfates. Most of the federal regulations that are applicable to power plants, such as the PSD regulations, NSPS, and ambient air quality standards, are based on the SO₂ portion of the SO_x mixture. MDE, however, regulates total SO_x emissions from fuel-burning equipment.

SO_x and NO_x emissions, when no pollution control systems are used, depend on the type of fuel burned more than any other variable. Generally, coal-fired boilers emit more NO_x per unit of energy (usually expressed in terms of pounds per million Btu (lb/MMBtu)) than oil-fired boilers. Coal-fired boilers at Maryland power plants emit NO_x in quantities ranging from 0.5 to 1.4 lb/MMBtu; oil-fired boilers emit between 0.3 and 0.7 lb/MMBtu. In the state, SO_x emissions from oil-fired boilers range from 0.3 to 2.1 lb/MMBtu; those from coal-fired boilers, from 1.1 lb/MMBtu to 3.5 lb/MMBtu (MDE 1989). The combustion of natural gas results in the lowest NO_x and SO_x emission rates (MDE 1989).

Fossil-fueled plants provided 85 percent of the electricity used in Maryland in 1987, with the balance supplied by nuclear-powered plants. The relative amounts of coal, oil, and gas from fossil fuel-powered plants in Maryland used to meet electricity needs in 1987 are shown in Figure 3-2. It is clear that coal-fired boilers produced the bulk (roughly 87 percent) of the fossil fuel generated electricity, while oil-fired equipment produced approximately 11 percent, and gas-fired equipment produced less than 2 percent (MDE 1989). However, there appears to be a shift toward the use of natural gas as the primary fuel, as evidenced by the increasing number of permit applications for new gas-fired combustion turbines in Maryland.

Adverse Effects

At high concentrations, NO can cause disturbances in the human central nervous system and circulatory system, and can affect enzyme production. NO₂ is considered to be more toxic than NO and, due to its low solubility in water, can penetrate to remote portions of the respiratory tract. At levels approaching the NAAQS, it can cause an increase in heart and lung disease in humans subjected to prolonged exposure (EPA 1981).

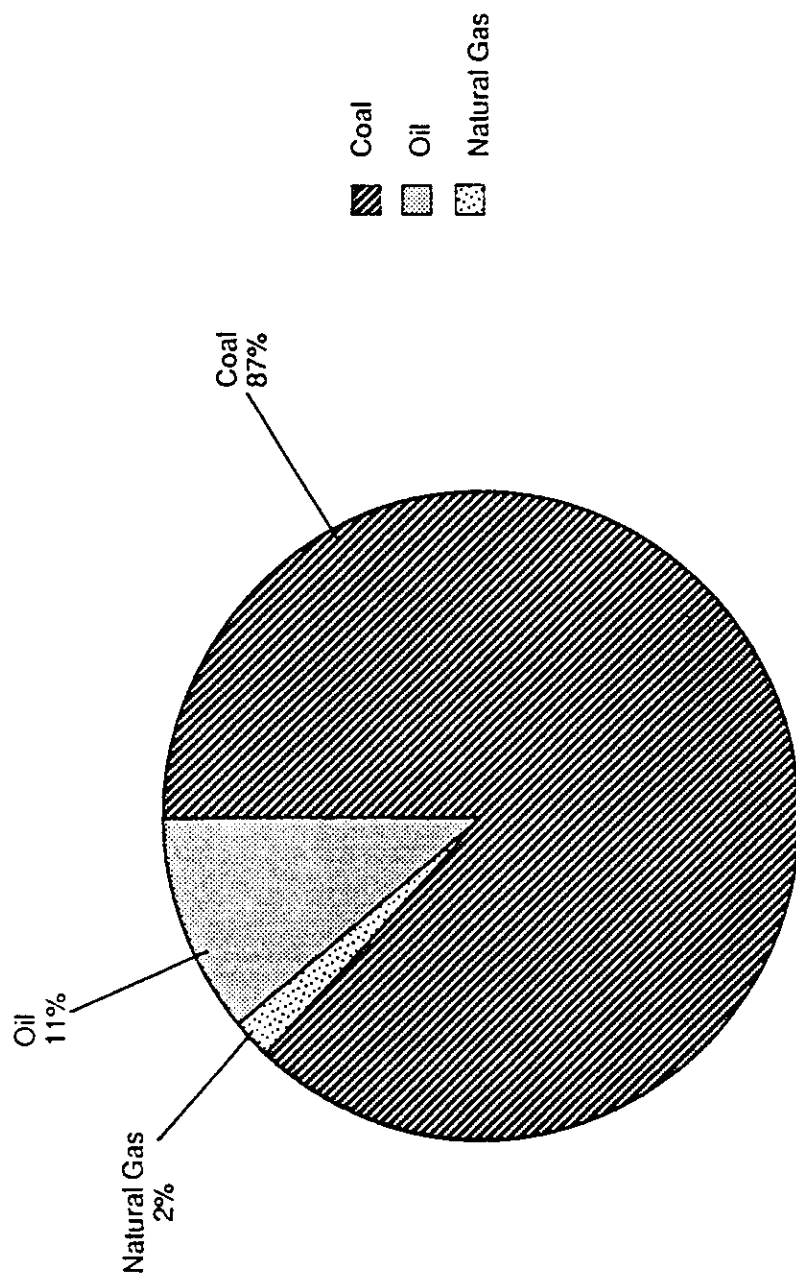


Figure 3-2. Maryland 1987 electricity production from fossil fuel powered plants by fuel type

Source: MDE 1989

Inhalation of SO₂ can also result in adverse health effects, primarily by affecting the respiratory system. These effects include breathing impairment, decreased ability of the lungs to dispose of foreign matter, and increased susceptibility of the lungs to disease. Chronic exposure to high levels of SO₂ can cause a higher incidence of coughs, shortness of breath, bronchitis, and fatigue (EPA 1981).

NO_x and SO_x Emissions and Impacts

Power plants are the dominant stationary sources of NO_x and SO_x emissions in Maryland, contributing about 70 percent of the NO_x and 85 percent of the SO_x emitted from stationary sources. Overall, power plant NO_x emissions accounted for about 40 percent of the total emissions in the state during 1987 (the most recent data available at the time of this writing). The remainder is attributable to mobile sources such as automobiles (45 percent), and industrial sources (15 percent). Although the number of vehicle miles driven in Maryland has increased over the past several years, the actual emissions of NO_x have not gone up proportionately, due to increased emissions control.

By contrast, most of the statewide SO_x emissions are attributable to stationary sources, and power plants in particular. Industrial and home heating sources contribute some SO_x. Mobile sources, however, contribute a minimal amount of SO_x emissions.

NAAQS establish maximum allowable ground level concentrations of NO₂ and SO₂. The primary and secondary NAAQS for NO₂ are based on an annual averaging period; for SO₂, standards have been established for annual, 24-hour, and 3-hour averaging times (Table 3-1). All of Maryland is currently in compliance, or "in attainment", with the NAAQS for NO₂ and SO₂. On the average, ambient concentrations of NO₂ have remained relatively constant over the past several years (Figure 3-3). Ambient concentrations of SO₂ have decreased somewhat since the early 1980s, but have remained relatively constant during the latter half of the decade (Figure 3-4) (MDE 1988).

Atmospheric dispersion models can be used to estimate the cumulative ground level impact from Maryland power plants. Individual modeling studies have been performed for almost all existing power plant facilities in the state. PPER's Model States Program can be used to predict cumulative impacts by utilizing its large database of air pollution dispersion modeling results. For this study, the Model States Program was used to estimate the combined annual air quality impact due solely to power plants in Maryland for 1987. The program examined 15 plants, composed of approximately 85 separate stack sources, using emission rates reported by Maryland AMA's annual emission inventories.

The program provides estimates of ground level concentrations of SO₂, NO₂, and TSP at locations spaced at 2.5 km intervals across the state. As with all dispersion modeling, the modeling for the Model States program makes several assumptions that affect the results -- assumptions about the terrain around each power plant, the local meteorology, and the sources of pollutants at each plant.

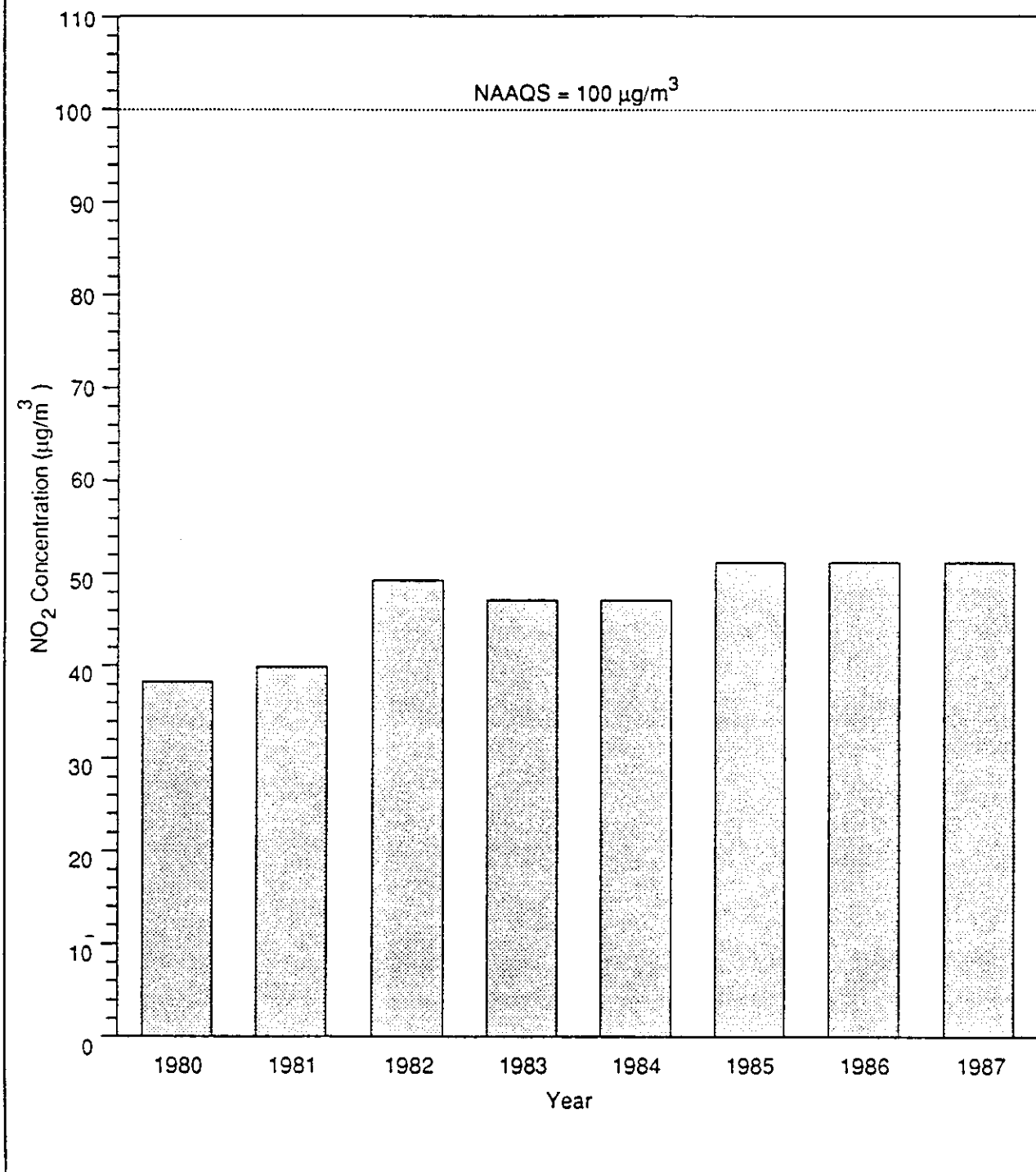


Figure 3-3. Historical average annual arithmetic mean ground level concentration of NO₂ in Maryland

Source: MDE 1988

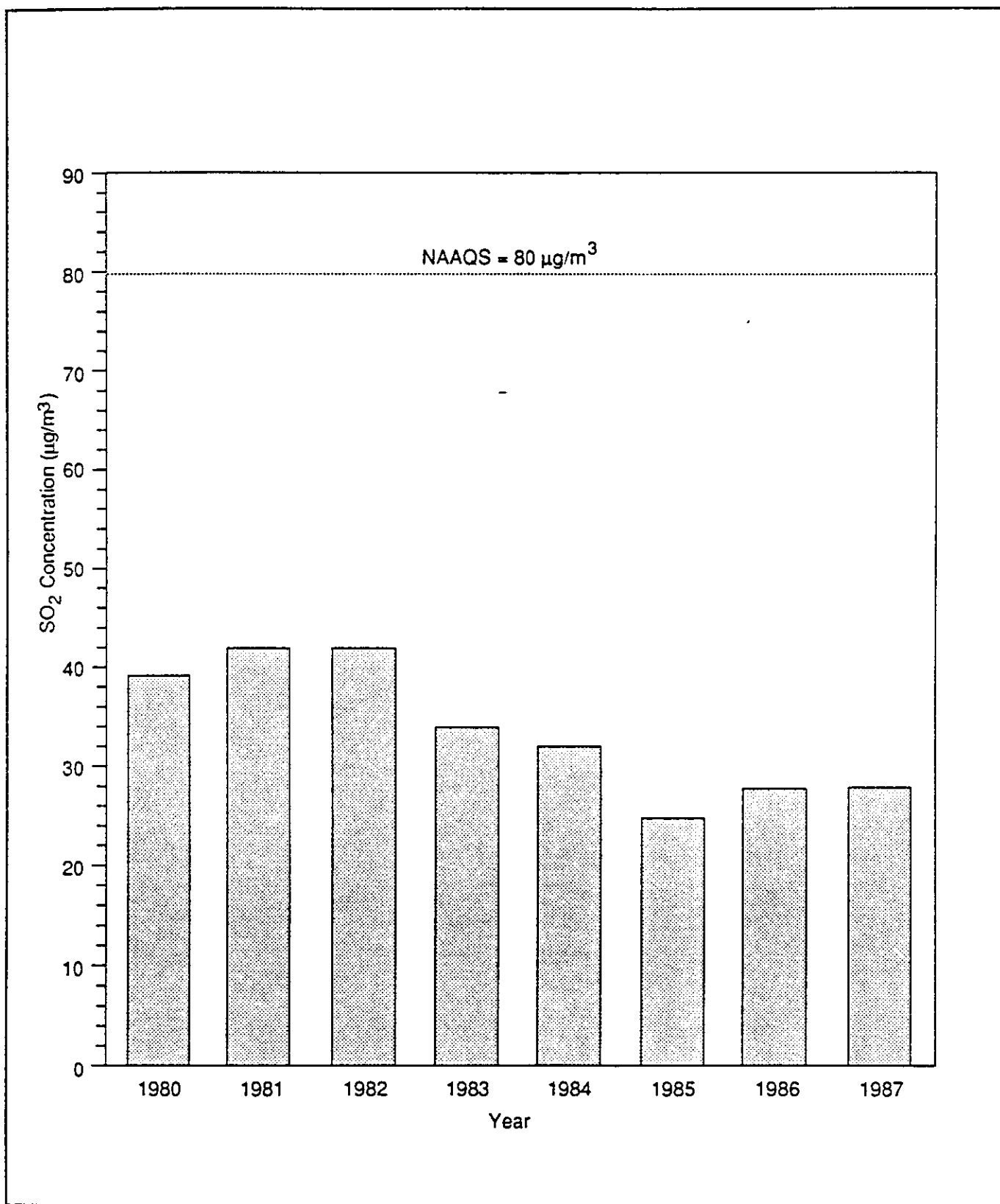


Figure 3-4. Historical average annual arithmetic mean ground level concentration of SO₂ in Maryland

Source: MDE 1988

For example, the Model States program assumes that all terrain around Maryland power plants is flat. The flat terrain assumption results in underestimating impacts in areas of uneven terrain, such as near the R.P. Smith and Dickerson plants.

Power plants are the only pollutant sources examined by the Model States analysis. Plots of the modeling results show higher pollutant concentrations near the plants, increasingly lower concentrations in areas far from power plants. Pollutant concentrations around isolated plants in more remote areas show up distinctly, and can be attributed directly to them. Concentrations around individual plants in and around Baltimore are indistinguishable, however, as they represent the combined impacts of several power plants.

Figures 3-5 and 3-6 present aggregated power plant impacts for SO₂ and NO₂ for the year 1987 as determined by Model States analyses. This analysis indicates that the highest predicted annual SO₂ concentration due to power plants was 3.5 µg/m³, which is less than 15 percent of the measured ambient SO₂ concentration. This comparison indicates that while power plants constitute a large portion of the state's SO₂ emissions, they are not the major contributor to the annual average ground level gaseous concentrations. Similarly, the Model States analysis predicts the highest ambient NO₂ concentration attributable to Maryland power plants to be approximately 2.4 µg/m³, while the average measured concentration is between 40 and 50 µg/m³. This, too, indicates that power plants are not the major contributor to ground level NO₂ gaseous concentrations. For the purpose of comparison, the SO₂ and NO₂ Model States results for 1977 are also included (Figures 3-7 and 3-8). The 1977 modeling predicted maximum values of 4.9 µg/m³ for SO₂ and 2.5 µg/m³ for NO₂. Because of the coarseness of the modeling grid (2.5 km resolution), it is possible that the results show lower values than would be predicted using a closer grid spacing.

The difference between the utilities' large portion of the overall emissions and their rather small impact on ground level concentrations can be explained in part by the characteristics of their discharge. Generally, power plant air emissions are released from relatively tall stacks at fairly high temperatures, which results in greater dispersion than emissions that are discharged at cooler temperatures from shorter stacks.

NO_x and SO_x Formation

NO_x is formed during combustion mainly in two ways. "Thermal NO_x" is formed during combustion by the thermal oxidation of atmospheric nitrogen. Its formation is a function of the boiler's combustion chamber design and operating parameters such as the flame temperature, the amount of excess air, and the residence time at the flame temperature. "Fuel NO_x" is formed through the reaction of nitrogen compounds in the fuel with the combustion air.

The oxides of nitrogen formed during the combustion of fossil fuels include nitric oxide (NO), nitrogen dioxide (NO₂), and nitrous oxide (N₂O). The atmospheric